



PIER Energy-Related Environmental Research

Environmental Impacts of Energy Generation, Distribution and Use

Ecosystem Feedbacks to Climate Change in California: Integrated Climate Forcing from Vegetation Redistribution

Contract #: MEX-07-08-09

Contractor: University of California, Merced

Contract Amount: \$74,882

Contractor Project Manager: Lara Kueppers

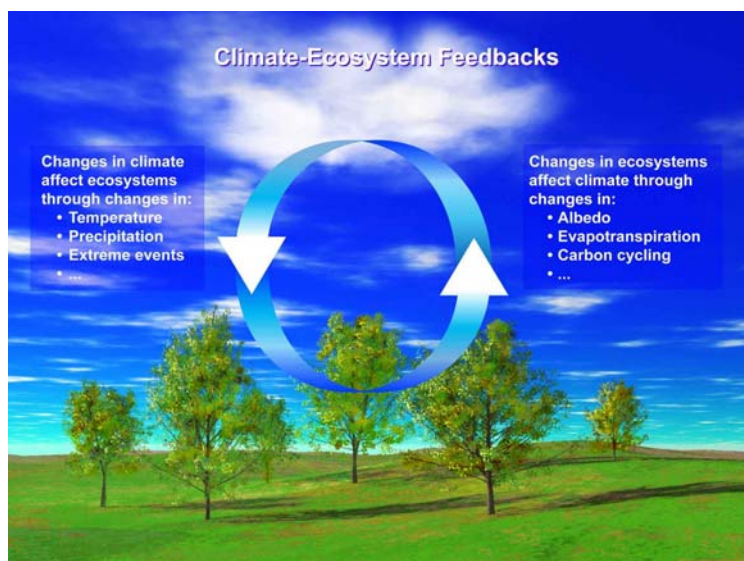
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The Issue

Reliance on fossil fuels—for electricity generation, among other uses—has led to atmospheric accumulation of greenhouse gases that affect climate. The resulting changes in California's climate are predicted to impact the state's water resources, public health, and diverse natural ecosystems.

In addition to being affected by climate change, ecosystems also affect climate, so that ecosystem responses to climate change may trigger follow-on changes in regional climate. This set of two-way interactions, known as climate-ecosystem feedbacks, is a dynamic that has not been well studied. A better understanding of climate-ecosystem feedbacks is important for improving predictions of regional climate change. Such knowledge will also help California's policy makers and citizens decide how to offset greenhouse gas emissions. For example, afforestation (planting forests) in areas that are currently rangelands would help soak up greenhouse gases from the atmosphere, but would have other effects on climate that have not yet been quantified.



Climate and ecosystems affect each other in a feedback loop. Current regional climate models do not account for these two-way interactions. (Figure courtesy Walter Denn, Lawrence Berkeley National Lab)

Regional-scale climate models have been increasingly used to predict climate change because they can represent relevant local details, such as mountain ranges and variation in vegetation type, at higher spatial resolution than can global climate models. The California Energy Commission has funded new regional climate modeling research with the goal of improving predictions of future

climate in California. This research will account for both the effects of greenhouse gases and the effects of urbanization and agricultural land use. Yet these new models will still contain a critical gap: the lack of two-way interactions between climate and vegetation that will result as climate change produces changes in ecosystems. California ecosystems are expected to alter their geographic distribution in response to climate change, and also in response to human-induced changes such as afforestation.

Project Description

This study, funded by PIER's Environmental Exploratory Grants Program, will use a regional climate model to estimate the relative importance of climate-ecosystem feedbacks to predictions of future climate change in California, with a particular emphasis on the role of native ecosystem shifts and regions proposed for afforestation. The project will:

1. Synthesize available predictions for changes in the geographic distribution of ecosystems resulting from climate change and afforestation.
2. Synthesize data quantifying how California ecosystems affect climate.
3. Customize a regional climate model to better represent California ecosystems' climatic influences.
4. Use the customized climate model to estimate potential climate-ecosystem feedback strength in California.

These estimates of climate-ecosystem feedback strength will help determine whether further work is needed to better understand and incorporate these two-way interactions into regional climate models.

PIER Program Objectives and Anticipated Benefits for California

This project offers numerous benefits and meets the following PIER program objective:

- **Evaluating and resolving environmental effects of energy production, delivery, and use.** By estimating the importance of climate-ecosystem feedbacks in California, this study will quantify the uncertainty associated with predictions of future climate and develop valuable input for refining climate models. Moreover, by estimating unintended climate effects from afforestation, this project will help local and state governments decide whether carbon sequestration via afforestation is a good option for mitigating climate change.

Final Report

PIER-EA staff intend to post the final report on the Energy Commission website in fall 2008 and will list the website link here.

Contact

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